CLAIMS

What is claimed is:

1. A system for maintaining a concentration range of an electroreducible metal species during electrolysis, comprising:

a first container for containing a body of a solution in which a metal is at least partially dissolved;

a second container in fluid communication with the first container and containing a second body of the solution, the dissolved metal in the second container having a concentration;

a means for electrolyzing the metal, the means at least partially immersed in the second body;

a means for sensing the concentration; and

a means for exchanging solution between the containers responsive to the sensed concentration.

2. The system of claim 1 further comprising a means for maintaining a temperature of the second body within a predetermined range.

3. The system of claim 2 wherein the temperature range is between about 25 degrees and about 65 degrees C.

4. The system of claim 2 wherein the temperature range is between about 40 degrees and about 55 degrees C.

5. The system of claim 2 further comprising a means for sensing the temperature of the second body, and a means for exchanging solution between the containers responsive to the sensed temperature.

6. The system of claim 2 further comprising a means for sensing the temperature of the second body, and a means for cooling the second body responsive to the sensed temperature.

7. The system of claim 6 wherein the means for cooling comprises a cooling coil at least partially immersed in the second body.

8. The system of claim 6 further comprising a means for heating the temperature of the second body responsive to the sensed temperature.

9. The system of claim 8 wherein the means for heating comprises a heating element at least partially immersed in the second body.

10. The system of claim 1 wherein the means for exchanging comprises a pump for circulating the solution between the first and second containers.

11. The system of claim 10 wherein the pump has an outlet that delivers the solution to the electrolyzing means, and an inlet in fluid communication with the first container.

12. The system of claim 11 wherein the pump inlet is coupled to a tempering valve having first and second valve inlets, the first valve inlet in fluid communication with the

first container, and the second valve inlet in fluid communication with the second container.

13. The system of claim 10 further comprising a dump valve for returning the solution from the second container to the first container.

14. The system of claim 1 wherein the dissolved metal is in a form of one or more oxides of the metal.

15. The system of claim 1 wherein the solution is a reaction product of an electrochemical reaction in a metal/air fuel cell.

16. The system of claim 1 wherein the dissolved metal is zinc.

17. The system of claim 1 wherein the solution is an aqueous solution.

18. The system of claim 17 wherein the aqueous solution comprises dissolved electrolyte and a suspension of metal oxide.

19. The system of claim 1 wherein the concentration is maintained between about 0.5M and 4.0M.

20. The system of claim 1 wherein the concentration is maintained between about 1.0M and 2.5M.

21. The system of claim 1 further comprising a means for sensing concentration of the dissolved metal in the first container, and a means for exchanging solution between the containers responsive to the sensed molarities.

22. A system for producing metal particles by electrolysis comprising:

a first container for containing a body of a solution in which a metal is at least partially dissolved;

a second container in fluid communication with the first container and containing a second body of the solution, the dissolved metal in the second container having a concentration;

a discrete particle electrolyzer at least partially immersed in the second body, comprising:

an anode at least partially immersed in the second body;

a cathode having a plurality of electrically coupled active zones separated from each other at the cathode surface by an insulator, each active zone formed of an electrically conductive material, said cathode at least partially immersed in the second body;

a channel for directing the solution including the dissolved metal between the anode and one or more of the active zones of the cathode; and

voltage means for applying an electric potential between the anode and cathode sufficient to cause metal particles to form on one or more of the active zones of the cathode;

a means for sensing the concentration; and

a means for circulating the solution from the first and second containers through the channel responsive to the sensed concentration, whereby the concentration may be maintained within predetermined limits during electrolysis.

23. The system of claim 22 wherein the concentration is maintained between about 0.5M and 4.0M.

24. The system of claim 22 wherein the concentration is maintained between about 1.0M and 2.5M.

25. The system of claim 22 further comprising a means for maintaining a temperature of the second body within a predetermined range.

26. The system of claim 25 wherein the temperature range is between about 25 degrees and about 65 degrees C.

27. The system of claim 25 wherein the temperature range is between about 40 degrees and about 55 degrees C.

28. The system of claim 22 further comprising a means for sensing the temperature of the second body, and a means for exchanging solution between the containers responsive to the sensed temperature.

29. The system of claim 22 further comprising a means for sensing the temperature of the second body, and a means for cooling the second body responsive to the sensed temperature.

30. The system of claim 29 further comprising a means for heating the temperature of the second body responsive to the sensed temperature.

31. A system for maintaining a concentration range of an electroreducible metal species during electrolysis, comprising:

a first container for containing a body of a solution in which a metal is at least partially dissolved;

a second container in fluid communication with the first container and containing a second body of the solution, the dissolved metal in the second container having a concentration;

an electrolyzer for electrolyzing the metal, the electrolyzer at least partially immersed in the second body;

a sensor for sensing the concentration; and

a pump for exchanging solution between the containers responsive to the sensed concentration.

32. A method for maintaining a concentration range of an electroreducible metal species during electrolysis, comprising:

containing in a first container a body of a solution including dissolved metal;

maintaining a second body of the solution in a second container in fluid communication with the first container, the dissolved metal of the second body having a concentration;

circulating the second body through an electrolyzer;

electrolyzing a portion of the dissolved metal of the second body in the electrolyzer;

sensing the concentration; and

exchanging solution between the first and second containers responsive to the sensed concentration.

33. The method of claim 32 further comprising maintaining a temperature of the second body within a predetermined range.

34. The method of claim 33 wherein the range is between about 25 degrees and about 65 degrees C.

35. The method of claim 33 wherein the range is between about 40 degrees and about 55 degrees C.

36. The method of claim 33 further comprising sensing the temperature of the second body, and wherein the maintaining step comprises exchanging the solution responsive to the sensed temperature.

37. The method of claim 36 wherein the maintaining step comprises heating the second body responsive to the sensed temperature.

38. The method of claim 36 wherein the maintaining step comprises cooling the second body responsive to the sensed temperature.

39. A method for maintaining a concentration range of an electroreducible metal species during electrolysis, comprising:

containing in a first container a body of a solution including dissolved metal;

maintaining a second body of the solution in a second container in fluid communication with the first container through valved ports, the dissolved metal of the second body having a concentration;

electrolyzing metal in the second body in an electrolyzer;

sensing the concentration;

if the sensed concentration falls within a predetermined range,

closing the ports; and

circulating the second body through the electrolyzer;

if the sensed concentration falls outside of the predetermined range,

opening the ports; and

circulating solution from the first container through the electrolyzer.

40. The method of claim 39 further comprising maintaining a temperature of the second body within a predetermined range.

41. The method of claim 40 wherein the range is between about 25 degrees and about 65 degrees C.

42. The method of claim 40 wherein the range is between about 40 degrees and about 55 degrees C.

43. The method of claim 40 further comprising sensing the temperature of the second body, and wherein the maintaining step comprises exchanging the solution responsive to the sensed temperature.

44. The method of claim 43 wherein the maintaining step comprises heating the second body responsive to the sensed temperature.

45. The method of claim 43 wherein the maintaining step comprises cooling the second body responsive to the sensed temperature.